DIESEL MECHANIC

MINING QUALIFICATIONS AUTHORITY

CODE: SPG - 1

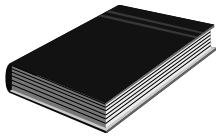
CUT AND FIT GASKETS

Created : 01 February 2003
Revised : March 2015
Owner : Learnership Department

First Published : March 2003
Revision No: 002
TRG 9

INDEX

The following elements are contained in this learning guide:



SOURCE REFERENCES

Demonstration by a competent person.

Manufacturers' catalogues and charts.

A display board in the training centre.

OBJECTIVE

You will be learning towards the outcome “Cut and fit gasket”. Whilst learning towards the outcome you will be required to achieve the following:

- Cut and fit gaskets of different shape and different types of material.

On completion of this module, the learner must be able to:

- Mark off and cut a full-face rubber insertion flange gasket.
- Mark off and cut a "Vellumoid" gasket of uneven shape.
- Use a hammer to cut out a "Klingerit" gasket on a machined face.
- Fit a ring gasket between two flange faces and tighten the bolts in the correct sequence and to the specified torque.

During this process you must adhere to certain specified requirements as listed in the Module.

ASSESSMENT AND EVALUATION CRITERIA

You will be assessed, when you are confident that you may achieve the outcomes as listed, to determine your competence as measured against the required criteria. This assessment will be in line with accepted best practices regarding assessment.

- A practical test will be set at the end of the module and must be completed without using references other than flange and torque tables and manufacturers’ catalogues.
- The learner will be required to mark off and cut different shape gaskets from different types of materials as directed, and to fit a ring gasket correctly between two flange faces.

The following standards must be achieved:

- The gaskets must fit correctly.
- The bolting sequence must be marked.
- The torque must be to the required specifications.
- There must be no damage to tools and equipment.

- All safety procedures must be adhered to.

HAZARD IDENTIFICATION AND CONTROL (HIAC) FORM

SPG - 1

CUT AND FIT GASKETS

STEPS IN OPERATION / PROCESS	POTENTIAL ACCIDENT / INCIDENT	CONTROLS (BY RESPONSIBLE PERSON)
1. Use hand tools.	• Using damaged tools or wrong tools for the job can cause injury and damage to equipment.	• Always use the correct tool for the job. • Ensure tools are in good condition. • Use tools correctly. • Wear appropriate PPE where necessary. • Always take good care of tools. Maintain, clean and store it properly.

NOTE: Before doing the practical work contained in this module, the learner must study the content of the above HIAC form again and then sign the statement below.

The above risks, which will be encountered in this module, are fully understood and will be controlled during the practical work.

Signature of learner: _____

Signature of Training Officer: _____

Date: _____

1. CUT AND FIT NON - METALIC GASKETS

ITEM / TASK: Introduction.

DESCRIPTION:

A. A gasket is a compressible piece of material, e.g. paper, asbestos, cork, rubber etc., which is sandwiched between the faces of a joint to form a seal.
B. All the types of seals, packing and gasket materials and methods of sealing and jointing dealt with in this module are used in the industry.
C. The name of products varies from manufacturer to manufacturer, although purpose, function and physical appearance of the product might be the same. For this reason, commonly used or descriptive names will be used as much as possible.

ITEM / TASK: Types of non - metallic gaskets.

DESCRIPTION:

A. **Rubber gasket material**.

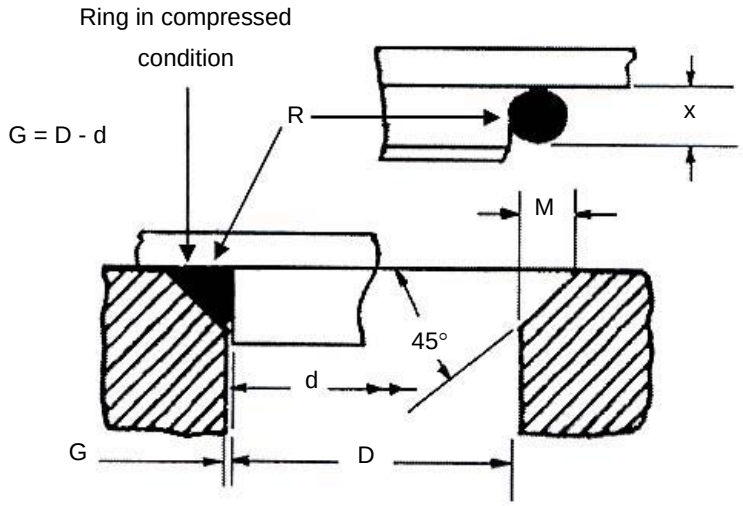
Rubber gaskets are suited mostly for sealing off water or air connections. It's not recommended for use with oil or where extreme heat is present. Oil and heat will affect rubber and make it soft and cause gasket failure. It can even result in blowouts.

There are basically three types of rubber gasket material:

- **Round rubber** (O-ring material) varies from 3mm to 12mm in diameter. This is available in rolls up to 50 metres in length.

  Round rubber can be cut into lengths and joined with an adhesive to form rings of any size. Some adhesives available are so strong that the rubber will snap rather than the joined part when under tension.

  Gaskets made up of round rubber are mostly used to seal off pump casing sections (cells) and other pump parts. Fig 1 and Table 1 on the next page show the relationship of the chamfer (M) and the radius (R) to the cross section of the rubber ring when applied to pumps.



D = Bore diameter

D = Diameter of a male spigot

FIG 1.

TABLE 1 - DETAILS OF MEASUREMENTS

X	$M^{+0,12}_{-0,00}$	R. MAX	G. MAX
1.6	2.2	0.8	0.12
2.4	3.3	1.3	0.12
3.0	4.2	2.0	0.15
5.7	7.8	3.0	0.18
8.4	11.5	4.0	0.20

X = Cross section diameter of a ring

M = Width of chamfer

R = Maximum radius of male spigot

G = Maximum clearance between spigots

- **Rubber insertion** is made out of cloth - reinforced laminated flat rubber, in various thickness and width rolls.

  Rubber insertion is ideal for making either gaskets or full face flange gaskets, which are used between the flange faces of low pressure pipe lines.

  Fig 2 shows a ring gasket, which fits inside the bolt circle on the flange and a full face gasket which covers the flange face on both the inside and outside of the bolt circle.

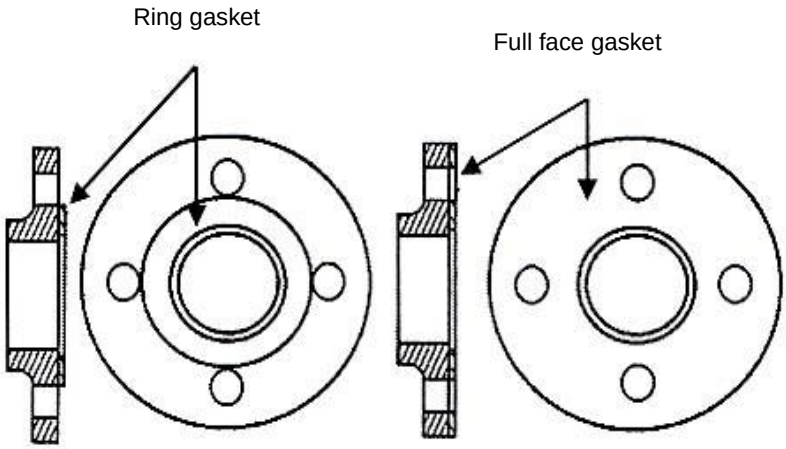


FIG 2.

- **Plain flat rubber** which is available in various width and thickness rolls.

  Plain flat rubber is mostly used as gasket material in special applications in gold and uranium refining plants. It is normally more compressible than rubber insertion, and it is resilient, i.e. it has the ability to assume its original shape and size, except when subjected to heat or when it is in an uncured state.

SELF TEST 1

1. Name four types of material used for gaskets.

- _____
- _____
- _____
- _____

2. What is a gasket?

_____

_____

_____

3. Name three types of rubber gasket material and where they are used.

- _____
- _____
- _____

4. If the cross section diameter of a rubber ring is 3 mm, determine the following values:

M = _____

R = _____

G = _____

Ask your Training Officer to check your work and if it is correct, to sign below.

LEARNER	TRAINING OFFICER
DATE :	DATE :
SIGNATURE :	SIGNATURE :

B. **Paper gasket material.**

Paper gasket material is normally a heavy strong paper, which resembles "vellum" and is commonly known as "Vellumoid". It is supplied in various width and thickness.

- It has a very low percentage of compressibility and is suitable for most applications, especially where oil or petrol is to be sealed off.
- It is not recommended for high pressures, for gaskets in pipe lines, or where extreme heat is present.

C. **Cork gasket material.**

Cork gasket material is basically cork chips moulded into flat sheets. It is supplied in rolls or in sheet.

- Three of the most common types of cork packing are :
  - Cork-rubber composition.
  - Cork-asbestos composition.
  - Plain cork.
- Cork packing is widely used in motor car engines where oil has to be sealed off, e.g. tappet covers and sumps.

D. **Compressed fibre gasket material.**

“Klingerit" is the most commonly used in the industry. It is available in standard size sheets of 1500mm x 2000mm and various thicknesses. Gaskets of any shape or size can be cut depending on the sheet size.

Klingerit is available in the following nine grades (types) to suit various applications:

- **Klingerit Universal** is suitable for withstanding high pressures and for virtually any liquids including hydro-carbons, alkalis and medium strength acids. It can be identified by its light blue colour.
- **Klingerit** is manufactured in different coloured sheets. The colour identifies the grade suitable for steam, water or non-corrosive solvents etc.
- **Klinger 200** is reddish-brown in colour and is suitable for steam, water, gases and other non-corrosive liquids.
- **Klinger 100** is dark grey in colour and is suitable for the same use as Klinger 200 but can withstand higher temperatures.

- **Klinger Oilit** is black in colour and is suitable for petrol, oils and solvents of all types.
- **Klingerit Frio** is green in colour and is suitable for refrigerants, i.e. freon, and is also used for water, saltwater, steam and gases.
- **Klinger Acidit L** is off-white in colour and is suitable for strong organic and non-organic acids.
- **Klingerit 1000** is light grey in colour and wire reinforced. It is able to withstand high pulsating pressures and high temperatures.
- **Klinger 80** is pinkish red in colour and of medium quality. It is suitable for general purpose use.

Note:

The grades of all the above types, except for the last one (Klinger 80) are printed on the sheets. Klinger 80 sheets are blank.

DO SELF-TEST 2 ON THE NEXT PAGE BEFORE CONTINUING WITH THE REST OF THE MODULE.

SELF TEST 2

1. Describe “Vellumoid” gasket material and state where it is mostly used and where it should not be used.

2. Name the three types of cork gasket materials.

- _____
- _____
- _____

3. Where is cork packing mostly used?

4. State which type of gasket material is suitable for use:
   a. Where high temperatures are present.

   b. Where high pressures are encountered.

Ask your Training Officer to check your work and if it is correct, to sign below.

LEARNER	TRAINING OFFICER
DATE :	DATE :
SIGNATURE :	SIGNATURE :

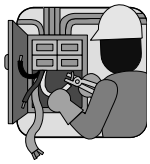
ITEM / TASK: Methods used to mark off and cut out gaskets.

DESCRIPTION:

There are basically four methods of marking off and cutting out gaskets, namely:

- Marking out the required shape and size on the material and cutting it out with a pair of tin snips.
- Using a cutting tool, such as a trammel, which has one pointed leg fixed to the end of a bar, and one adjustable sliding leg fitted with a knife blade.
- Making an impression of the gasket shape on the material and then cutting it out with a pair of tin snips.
- Using a component part to which the gasket is to be fitted as a template, and tapping along the edges with a hammer.

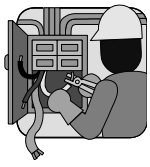
ITEM / TASK: Examples of marking off and cutting out gaskets.



DESCRIPTION:

A. **Cutting a full face pipe flange gasket.**

- Select the correct grade and thickness of material.
- Obtain the outside diameter (OD), the inside diameter (ID) and the pitch circle diameter (PCD) from the Training Officer or from Table 2 on the next page. Read the note below the table.
- Mark off the centre of the gasket.
- Set the dividers and mark out the ID, OD and PCD.
- Cut out the gasket.
- Select a bell punch equal in size to the bolt holes.
- Punch out the holes with a hammer.



B. **Cutting out a pipe flange ring gasket.**

- Select the correct grade and thickness of material.
- Obtain the OD and ID of the ring gasket from the Training Officer or from Table 2.
- Mark off the centre of the gasket.
- Set the cutting tool to the OD radius of the gasket.
- Locate the fixed leg of the cutting tool in the centre mark.

- Apply light even pressure on the adjustable leg and turn the tool out to cut a full circle on the material. Continue cutting in this way until the blade has cut through the material.
- Adjust the cutting tool to the ID radius of the gasket and cut out as explained above.

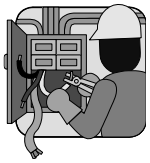
TABLE 2 - TYPICAL DETAILS OF PIPE FLANGE AND GASKET SIZES

a	b	c	d	e	f
15	95	21	52	67	4 x 16
20	102	27	59	73	4 x 16
25	114	34	68	83	4 x 16
32	121	43	73	87	4 x 16
40	133	48	84	92	4 x 16
50	152	60	95	114	4 x 19
75	184	89	127	146	4 x 19
100	216	114	159	178	4 x 19
150	279	165	216	235	8 x 22
200	337	219	273	292	8 x 22
250	406	273	333	356	8 x 25
300	457	324	384	406	12 x 25
350	527	381	445	470	12 x 29
400	579	432	495	521	12 x 29
450	641	483	559	584	12 x 29
500	705	533	616	641	16 x 29

NB: a = Nominal pipe bore size in mm
b = Outside diameter of flange and full face gasket in mm
c = Inside diameter of full face or ring gasket in mm
d = Outside diameter of ring gasket
e = Pitch circle diameter (PCD) in mm
f = Number and size of holes in mm

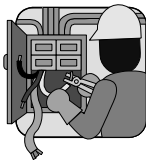
Note:

Pipe flange sizes depend on the pipe inside and outside diameter, the purpose for which the pipes are being used (i.e. application, pressure in the pipes etc.) and the type of material the pipes are made of.



C. **Marking out and cutting out a gasket of uneven shape.**

- Wipe the face of the component part for which the gasket has to be cut with old oil, grease or marking blue.
- Select the correct grade and thickness of material.
- Place the material over the face of the part, hold it steady and rub your hand along the inner and outer edges of the profile of the part.
- If the impression made on the gasket material is clear, cut along the profile with a pair of tin snips.
- If the impression is not clear, follow the general line of the profile with a pencil before cutting the gasket.
- Punch out any bolt holes.

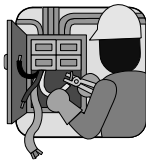


D. **Cutting a gasket by using the component part as a template.**

- Select the correct grade and size of material.
- Place the material on the face of the part, taking care that it covers the full face.
- Rub your thumb over the material to make a slight indentation over one of the bolt holes.
- Tap the material along the edges of the indentation with the ball of the hammer.
- Fit a bolt loosely through the hole to hold the gasket.
- Repeat the above three steps to cut another hole opposite the first hole and fit a second bolt.
- Tap along the outer and inner profile of the component part with the striking face of the hammer until the full gasket has been cut.
- Cut out the balance of the holes in the same way as explained above.

DO THE PRACTICE ON THE NEXT PAGE BEFORE

CONTINUING WITH THE REST OF THE MODULE.



PRACTICE

1. Cut a full face gasket for a 75mm pipe flange out of 2mm thick "klinger" 80 material.
2. Cut a ring gasket for a 100mm pipe flange out of "rubber insertion".
3. Cut a "Vellumoid" gasket for a cover of uneven shape by making an imprint on the material.
4. Cut a gasket of uneven shape out of 1mm thick "klingerit" using a hammer.

Ask your Training Officer to check your work and if it is correct, to sign below and then go on to the next section.

LEARNER	TRAINING OFFICER
DATE :	DATE :
SIGNATURE :	SIGNATURE :

ITEM / TASK: Fitting gaskets.

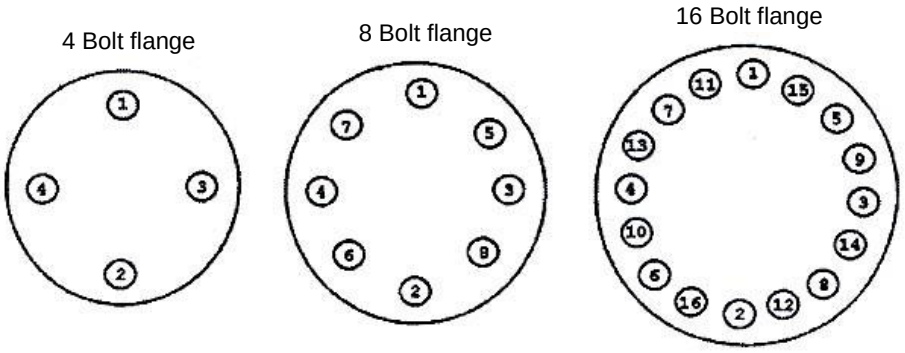
DESCRIPTION:

Once the gasket has been marked off and cut out, the most important aspect of fitting it is to tighten and torque the holding bolts correctly to ensure that the flange is not cocked and the gasket not crushed.

The following is an example of fitting a 3mm thick “klingerit” gasket between two 150mm flanges. Fig 3 shows the tightening sequence for a 4 bolt, 8 bolt and 16 bolt flange:

- Fit the bolts in the holes and **finger-tighten** them.
- Number the bolts in the sequence of tightening. (Fig 3)

Note that the first two bolts are first tightened diagonally across, then at right angles and the in between.

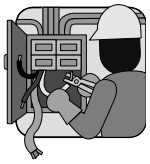


Bolting-tightening sequences

FIG 3.

- Consult the appropriate torque tables for the correct torque for the type of bolts being used.
- Initially tighten the bolts to 30% of the recommended bolt torque to prevent cocking of the flange and crushing of the gasket.
- After reaching the recommended torque, do a clockwise bolt to bolt torque check to make sure that the bolts have been tightened evenly.

DO THE PRACTICE ON THE NEXT PAGE BEFORE CONTINUING WITH THE REST OF THE MODULE.



PRACTICE

Practice fitting the gaskets that you have cut out in the previous practice using low tensile bolts, and tightening the flanges to the correct torque.

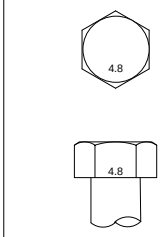
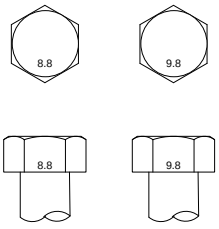
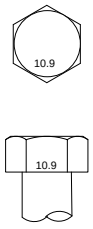
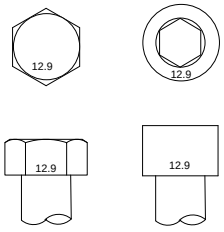
See Table 3 on the following pages for torque values.

Ask your Training Officer to check your work and if it is correct, to sign below and then go on to the next section.

LEARNER	TRAINING OFFICER
DATE :	DATE :
SIGNATURE :	SIGNATURE :

TABLE 3 - TORQUE VALUE

METRIC BOLTS & NUTS

Property Class and Head Markings	4.8 	8.8 9.8 	10.9 	12.9 
Property Class and Nut Markings	5 	10 	10 	12 

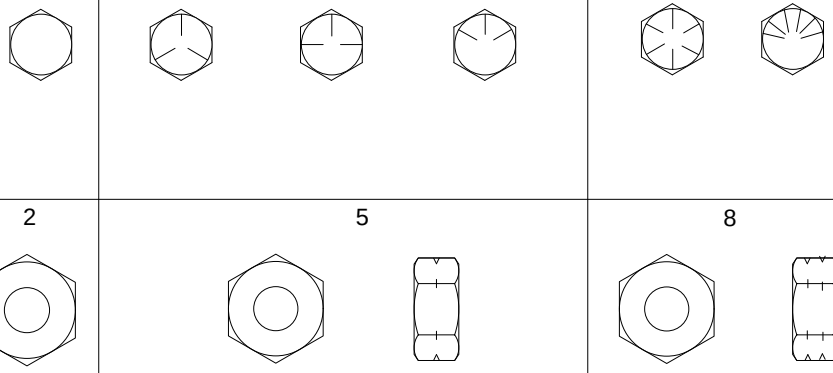
Size	Class 4.8				Class 8.8 or 9.8				Class 10.9				Class 12.9			
	Lubricated		Dry		Lubricated		Dry		Lubricated		Dry		Lubricated		Dry	
	Nm	Lb-ft	Nm	Lb-ft	Nm	Lb-ft	Nm	Lb-ft	Nm	Lb-ft	Nm	Lb-ft	Nm	Lb-ft	Nm	Lb-ft
M6	4.8	3.5	6	4.5	9	6.5	11	8.5	13	9.5	17	12	15	11.5	19	14.5
M8	12	8.5	15	11	22	16	28	20	32	24	40	30	37	28	47	35
M10	23	17	29	21	43	32	55	40	63	47	80	60	75	55	95	70
M12	40	29	50	37	75	55	95	70	110	80	140	105	130	95	165	120
M14	63	47	80	60	120	88	150	110	175	130	225	165	205	150	260	190
M16	100	73	125	92	190	140	240	175	275	200	350	225	320	240	400	300
M18	135	100	175	125	260	195	330	250	375	275	475	350	440	325	560	410
M20	190	140	240	180	375	275	475	350	530	400	675	500	625	460	800	560
M22	260	190	330	250	510	375	650	475	725	540	925	675	850	625	1075	800
M24	330	250	425	310	650	475	825	600	925	675	1150	850	1075	800	1350	1000
M27	490	360	625	450	950	700	1200	875	1350	1000	1700	1250	1600	1150	2000	1500
M30	675	1490	850	625	1300	950	1650	1200	1850	1350	2300	1700	2150	1600	2700	2000
M33	900	675	1150	850	1750	1300	2200	1650	2500	1850	3150	2350	2900	2150	3700	2750
M36	1150	850	1450	1075	2250	1650	2850	2100	3200	2350	4050	3000	3750	2750	4750	3500

Lubricated means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings.

Dry means plain or zinc plated without any lubrication.

IMPERIAL BOLTS & NUTS

SAE Grade and Head Markings	No Mark	1 or 2	5, 5.1, 5.2	8, 8.2
SAE Grade and Nut Markings	No Mark	2	5	8



Size	Grade 1				Grade 2				Grade 5, 5,1 or 5,2				Grade 8 or 8.2			
	Lubricated		Dry		Lubricated		Dry		Lubricated		Dry		Lubricated		Dry	
	Nm	Lb-ft	Nm	Lb-ft	Nm	Lb-ft	Nm	Lb-ft	Nm	Lb-ft	Nm	Lb-ft	Nm	Lb-ft	Nm	Lb-ft
1/4	3.7	2.8	4.7	3.5	6	4.5	7.5	5.5	9.5	7	12	9	13.5	10	17	12.5
5/16	7.7	5.5	10	7	12	9	15	11	20	15	25	18	28	21	35	26
3/8	14	10	17	13	22	16	27	20	35	26	44	33	50	36	63	46
7/16	22	16	28	20	35	26	44	32	55	41	70	52	80	58	100	75
1/2	33	25	42	31	53	39	67	50	85	63	110	80	120	90	150	115
9/16	48	36	60	45	75	56	95	70	125	90	155	115	175	130	225	160
5/8	67	50	85	62	105	78	135	100	170	125	215	160	215	160	300	225
3/4	120	87	150	110	190	140	240	175	300	225	375	280	425	310	550	400
7/8	190	140	240	175	190	140	240	175	490	360	625	450	700	500	875	650
1	290	210	360	270	290	210	360	270	725	540	925	675	1050	750	1300	975
1 1/8	470	300	510	375	470	300	510	375	900	675	1150	850	1450	1075	1850	1350
1 1/4	570	425	725	530	570	425	725	530	1300	950	1650	1200	2050	1500	2600	1950
1 3/8	750	550	950	700	750	550	950	700	1700	1250	2150	1550	2700	2000	3400	2550
1 1/2	1000	725	1250	925	990	725	1250	930	2250	1650	2850	2100	3600	2650	4550	3350

Lubricated means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings.

Dry means plain or zinc plated without any lubrication.

2. METALLIC RING GASKET

ITEM / TASK: Introduction.

DESCRIPTION:

A. **Metallic (or "spiral flex") ring gaskets** are made out of thin pre-formed metal strips, spiralled and filled with a soft non-metallic substance such as asbestos.

B. This type of gasket is ideal for use where extreme temperatures and high pressures are encountered.

C. There are basically two types of gaskets available in this range, namely:
   - Plain ring gaskets.
   - Ring gaskets fitted with a compression guide ring.

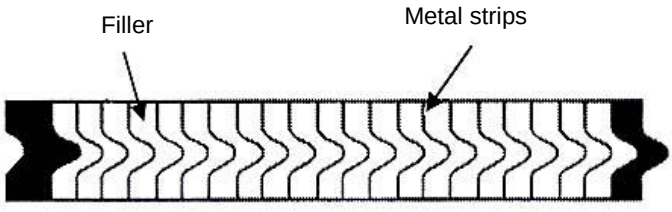
Note:

The fitting of ring gaskets will be demonstrated by your training officer.

ITEM / TASK: Types of ring gaskets.

DESCRIPTION:

A. **The plain ring gasket.**
   - Fig 4 shows an enlarged cross section of the plain ring gasket.
   - The standard thickness of this gasket is 3mm and it is recommended for use between flanges as shown in Fig 5.



Cross-section of a gasket

FIG 4.

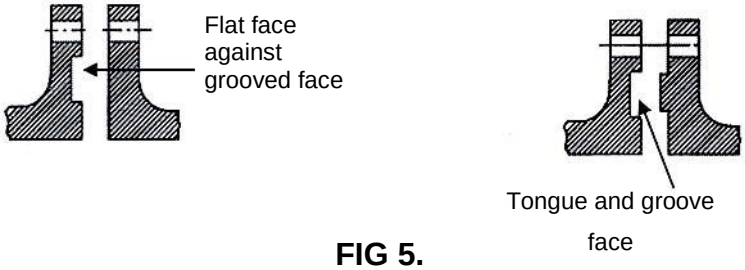


FIG 5.

B. **The ring gasket fitted with a compression guide ring.**

- Fig 6 shows an enlarged cross section of a "spiral flex" gasket fitted with a compression guide ring. The compression guide ring can be fitted either on the inside diameter or on the outside diameter of the gasket.
- The standard thickness for this type of gasket is 4mm and for the guide ring it is 3mm. The purpose of the compression guide ring is:
  - to prevent over compression and crushing of the gasket, and
  - to increase radial strength and prevent gasket blow-out.
- Ring gaskets fitted with compression guide rings are recommended for use in flanges where the gaskets are unconfined or only semi-confined. (Fig 7)

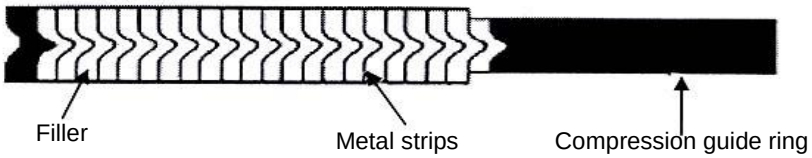


FIG 6.

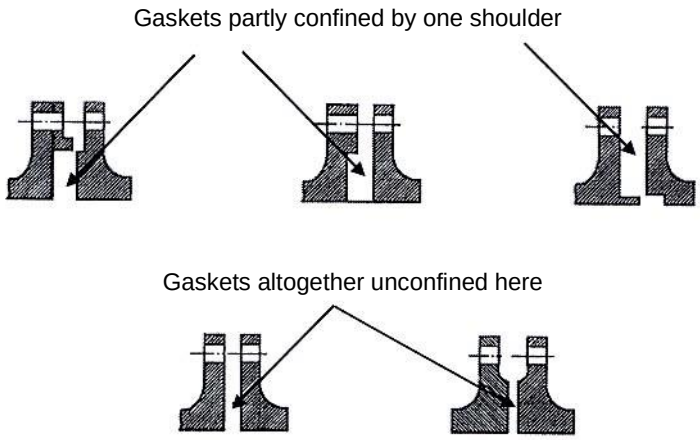


FIG 7.

DO SELF TEST 3.

SELF TEST 3

1. Describe the metallic spiral flex ring gasket and state where it may be used.

2. Give two advantages of a metallic spiral flex ring gasket fitted with a compression guide ring.

- _____
- _____

Ask your Training Officer to check your work and if it is correct, to sign below.

LEARNER	TRAINING OFFICER
DATE :	DATE :
SIGNATURE :	SIGNATURE :

REMEMBER ALWAYS WORK SAFE

Once you have passed the entire self tests and practices, you are now at liberty to request a Formative Assessment from your Assessor.